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19JUL02 E734600-1-C66961  
P01/7700 0.00-0216768.2

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3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

UCB, S.A.

Allée de la Recherche 60, B-1070 BRUSSELS (Belgium)

Patents ADP number *(If you know it)*

8428716001

Belgium

4. Title of the invention

Polymeric Film

5. Name of your agent *(If you have one)*

Martin KIRK

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Martin KIRK,  
c/o Neil DUTTON,  
UCB FILMS Plc., Station Road, Wigton, Cumbria CA7 9BG, United Kingdom

Patents ADP number *(If you know it)*

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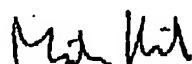
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11.



Martin KIRK

I/We request the grant of a patent on the basis of this application.

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12. Name and daytime telephone number of person to contact in the United Kingdom

Dutton Neill, UCB Films Plc. 016973 41591

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POLYMERIC FILM

The present invention relates to films of improved conformability suitable for use as a label on a deformable and/or irregular shaped articles (such as a squeezable plastic bottle or graphic art displays).

It is desirable to provide improved polymeric films which conform better to irregular surfaces to which the film may be applied for example when used as a facestock in the label or graphic art fields. Previous films which were highly conformable were often unsuitable for use as labels. To achieve improved levels of conformability required unacceptable compromises on other film properties also desired or necessary in a label. For example conformable labels had unacceptable optical properties e.g. insufficient clarity for a transparent label to achieve a "no-label look". Or for example films would be mono-axial (oriented in the machine direction only) to provide stiffness for label dispensing in the MD and yet "give" in the TD for conformability.

WO0054968 (Mobil) describes a multi-layer film with core layer of isotactic polypropylene, other syndiotactic polypropylenes, ethylene copolymers (such as ethylene-propylene copolymer, ethylene-butene-1 copolymer, butene-1-propylene random copolymer and ethylene-propylene block copolymer) and terpolymers which include other monomers such as propylene and/or butene-1 (such as ethylene-propylene-butene-1 terpolymer). Alternative thermoplastic materials suggested for the core layer include nylon, polyester, ethylene-vinyl acetate copolymer, and ethylene-vinyl alcohol copolymer. Blends of any of the foregoing homopolymers, copolymers and terpolymers are also suggested.

The applicant has developed a novel film using a particular polymer as the core layer which provides a film of improved conformability suitable for use as a label on deformable substrates. The film exhibits reduced creasing and visual blemishes after repeated deformation yet retains acceptable performances of other properties such as good optical performance desired for a translucent or transparent label film.

The present invention provides sheets which address some or all of these problems and are particularly suited for use in the aforementioned applications.

Therefore broadly in accordance with the present invention there is provided a biaxially oriented polyolefin single or multi-layer film which comprises at least one core layer comprising a propylenic polymer component and either an ethylenic polymer component or

a styrenic polymer component characterised in that the dynamic loss modulus ( $E''$ ) of the film measured at 3 Hz and 25°C is:

- (a) less than about 50 MPa measured in the transverse direction (TD); and/or
- (b) less than about 100 MPa measured in the machine direction (MD).

5

Preferred values for  $E''$  measured as described above for the total film of the present invention are:

when measured in the TD, less than about 40 MPa, more preferably less than about 30 MPa, most preferably about 4.0 MPa; and

10 when measured in the MD, less than about 65 MPa, more preferably less than about 50 MPa, most preferably about 8.0 MPa.

As used herein a polymer component may mean the polymer is present as a homopolymer (optionally in physical mixture with another polymer) or as part of a copolymer formed from 15 the appropriate monomer.

The core layer may comprise: a blend of propylene and ethylene homopolymers; a blend of propylene and with a saturated styrenic block copolymer; and/or a co-polymer formed from at least propylene and ethylene monomers.

20

As used herein the term copolymer includes polymers made from two or more different monomers (i.e. includes terpolymers)

25

Dynamical Mechanical Thermal Analysis (DMTA) characterizes the viscoelastic properties of materials. DMTA measures the modulus (stiffness) and the damping (energy dissipation) properties as a material deforms under periodic stress. Viscoelastic behavior of a polymer means that it has both solid and liquid characteristics that change with temperature, time or frequency. To measure viscoelastic properties, a DMTA applies a sinusoidal force to a sample then measures the resulting sample deformation or strain. The sample strain response lags 30 behind the input stress wave with respect to time and the lag is known as the phase angle.

35

The ratio of the dynamic stress to the dynamic strain provides the complex modulus that includes both the dynamic storage modulus, ( $E'$ ) and the dynamic loss modulus ( $E''$ ). The dynamic storage modulus refers to the ability of a material to store energy and is related to the stiffness of the material. The dynamic loss modulus  $E''$  ('out of phase' modulus) represents the heat dissipated by the sample as a result of molecular motions and reflects the damping characteristics due to the visco-elastic properties of the polymer. Without wishing

to be bound by any mechanism it is believed the smaller the value of  $E''$  (the dynamic loss modulus) the more recoverable is the label.

5 The core layer is preferably self supporting. Although the film may be single ply (i.e. where the core layer is the only layer) the film may also be multi-layered – i.e. where the film also comprises at least one additional layer adjacent to the core layer.

Preferably the co-polymer in core layer is selected from: a random and/or block copolymer or terpolymer optionally comprising up to about 50% of PE.

10

More preferably the core layer comprises one of:

- a) a blend of PP homopolymer and a PP/PE random copolymer;
- b) a blend of PP homopolymer and a PP/PE block copolymer;
- c) a terpolymer of PP, PE and polybutylene (PB);
- 15 d) a blend of a PP/PE random copolymer and a PP/PE block copolymer;
- e) a PP/PE random copolymer;
- f) a PP/PE block copolymer; and/or

where in the co or ter polymers the PE comprises up to about 50% by weight.

20 Usefully the core layer consists of

- (i) from 0% to 100% by weight of (i) a PP/PE random copolymer; and
- (ii) from 100% to 0% by weight of (ii) a PP/PE block copolymer;
- (iii) from 0% to 10% of other known suitable additives (such as wax etc).

25 More usefully

- (ii) the PP/PE random copolymer is present in an amount from 0% to about 60%, for example 0%, 18.5%, 27.5%, 36.9% or 53.0% by weight of the core layer; and/or
- (iii) the core layer is substantially free of additives.

30 PP / PE random and/or block copolymers may comprise any proportion of the constituent PE or PP components. Preferred PP/PE random copolymers comprises from about 0.2 % to about 5%, more preferably about 3.5 % by weight of PE. Preferred PP/PE block copolymers comprise from about 5 % to about 50%, more preferably from about 5 % to about 12% most preferably about 7.5 % by weight of PE.

35

Suitable additives can be selected from one or more of the following, mixtures thereof and/or combinations thereof: UV absorbers, dyes; pigments, colorants; metallised and/or

pseudo-metallised coatings; lubricants, anti-static agents (cationic, anionic and/or non-ionic, e.g. poly-(oxyethylene) sorbitan monooleate), anti-oxidants, surface-active agents, stiffening aids, slip aids (for example hot slips aids or cold slip aids which improve the ability of a film to slide satisfactorily across surfaces at about room temperature, e.g. micro-crystalline wax;

5       gloss improvers, prodegradants, barrier coatings to alter the gas and/or moisture permeability properties of the film (such as polyvinylidene halides, e.g. PVdC); anti-blocking aids (for example microcrystalline wax, e.g. with an average particle size from about 0.1 to about 0.6µm); tack reducing additives (e.g. fumed silica); particulate materials (e.g. talc); additives to reduce coefficient of friction (COF) (e.g. terpolymers of about 2 to 15 weight % of acrylic

10      or methacrylic acid, 10 to 80 wt. % of methyl or ethyl acrylate, and 10 to 80 weight % of methyl methacrylate, together with colloidal silica and carnauba wax, as described in US 3753769); sealability additives; additives to improve ink adhesion and/or printability, cross-linking agents (e.g. melamine formaldehyde resin); adhesive layers (e.g. a pressure sensitive adhesive); and/or an adhesive release layers (e.g. for use as a liner in peel plate label applications).

15      Some or all of the additives listed above may be added together as a composition to coat the films of the present invention and/or form a new layer which may itself be coated and/or may form the outer or surface layer of the sheet. Alternatively some or all of the preceding additives may be added separately and/or incorporated directly into the bulk of the core layer

20      optionally during film formation (e.g. as part of the original polymer composition), and thus they may or may not form layers or coatings as such. If the core layer is the only layer (i.e. the film of the invention is a single ply film) then the additives included may be those (such as some of those listed herein) more suitable for a surface layer of a film.

25      A random PP-PE copolymer means a copolymer comprising a polymer chain in which the polypropylene and ethylene units are distributed in accordance with random statistics with no preference for long runs of one or other unit beyond that required to achieve the overall desired composition. Such copolymers are conveniently prepared by simultaneously feeding propylene and ethylene in the desired proportions to a catalysed polymerisation zone. A block

30      PP-PE copolymer means a copolymer which comprises linked homogenous regions formed largely from one of the propylene or ethylene monomers.

The polymers used in the core layer herein can be made by any conventional method such as Ziegler-Natta catalysis or metallocene catalysis.

35      The film of the Invention can be a single layer of the core layer as described herein. However, it is preferred that films of the present invention sheets are multi-layered, i.e. consist of a

plurality of layers. The layers can be combined by lamination or co-extrusion. More preferably the sheets consist of at least three layers where the or each core layer is sandwiched between other layers such that none of the core layers forms either outer surface of the sheets.

5

Films of the invention can also be made by the laminating of two co-extruded films. Application of the outer layer(s) onto the core layer is conveniently effected by any of the laminating or coating techniques conventionally employed in the production of composite multi-layer films. Preferably, however, one or more the outer layers are applied to the 10 substrate by a co-extrusion technique in which the polymeric components of the core and outer layers are co-extruded into intimate contact while each is still molten. Preferably, the co-extrusion is effected from a multi-channel annular die so designed that the molten polymeric components constituting individual layers of the composite film merge at their boundaries within the die to form a single composite structure which is then extruded from a common die 15 orifice in the form of a tubular extrudate. It will be appreciated that any other shape of suitable die could also be used such as a flat die.

For example, a film of the invention can have three layers with the polymer of a central or core 20 layer being formed from the second polymeric material. The core layer may have a thickness of about 90 to about 98% of the total thickness of the film. The remainder of such three layer films can then have two outer layers of the first polymeric material, with each outer layer having substantially identical thicknesses.

Other films of the present invention consist of five co-extruded layers with a central core layer, 25 two layers contiguous to the central core layer and two outermost layers, where the central core layer and such contiguous layers include the second polymeric material and the two outer layers are formed from the first polymeric material. Preferably the central core layer has a thickness from about 70% to about 96%, more preferably from about 76% to about 90%, of the total thickness of the film. Preferably each of such contiguous layers has substantially the 30 same thickness, which is more preferably from about 1% to about 6%, and most preferably from about 1% to about 2%, of the total thickness of the film. Preferably each outer layer has substantially the same thickness, which is more preferably from about 1% to about 6%, and most preferably from about 1% to about 2%, of the total thickness of the film.

35 One or more of layers of films of the present invention can be opaque or transparent, depending on the end use of the film. Such layers can also include voids introduced by stretch orienting a layer containing particles (preferably substantially spherical particles) of a

material which is higher melting than and immiscible with the layer material (e.g. if the layer is formed from isotactic polypropylene homopolymer, such particles can be of polybutylene terephthalate, as described, for example, in US 4632869 and US 4720716).

5 The polymers of the outer layers (i.e. non core layer or layers) of the film can also be fabricated from suitable any polymers, copolymers or terpolymers or blends of homopolymers and blends of copolymer(s) and homopolymer(s) which provide the desired properties to these outer layers. It will be appreciated that such outer layers are preferably made from materials selected to have the same or more conformability than the core layer so that the overall 10 conformability of the film is not reduced by the presence of the outer layers. As the outer layers need not be self supporting as they are supported by the core layer there are less constraints on their composition compared to the core layer.

15 Suitable outer layers comprises isotactic propylene homopolymers, or for example, a copolymer of propylene with a minor amount of one or more other  $\alpha$ -olefins, such as ethylene and/or butylene-1 and/or other suitable terpolymers known in the art.

20 The polymeric film of the invention is oriented by stretching at a temperature above the glass transition temperature of the polymer(s). For example, orientation of a film having a propylene homopolymer substrate layer is conveniently effected at a temperature within a range of from about 145 to 165°C. Biaxial orientation is effected by stretching the film in each of two mutually perpendicular directions in the plane of the film. The biaxial orientation may be balanced or unbalanced, for example with the higher degree of orientation of an unbalanced film in a preferred direction - usually the transverse direction. A balanced biaxially oriented 25 film is preferred.

30 Conveniently, the material which forms the core and outer layers are co-extruded in the form of a composite tube which is subsequently quenched, reheated, and then expanded by internal gas pressure to induce transverse orientation, and withdrawn, at a rate greater than that at which it is extruded, to stretch and orient it in the machine direction. Alternatively, a flat, multiple-layer film may be oriented by simultaneous or sequential stretching in each of two mutually perpendicular directions by means of a stenter, or by a combination of draw rolls and a stenter.

35 The degree to which the film substrate is stretched depends to some extent on the ultimate use for which the film is intended, but for a propylene polymer-based film satisfactory tensile and other properties are generally developed when the film is stretched to between three and

ten, preferably, five to eight, times its original dimensions in each of the transverse and longitudinal directions. A preferred advantage of films of the present invention is that biaxial orientation (which acts to make the film more stiff in the oriented direction) can be achieved in a film with acceptable conformability.

5

After stretching, the polymeric film may be thermally treated, for example, by a system of one or more heated rollers, as disclosed, for example, in GB-A-1124886. The aforementioned thermal treatment is preferably at a temperature in the range from 40° to 130°C. Alternatively, or additionally, the film may be subjected to a constrained heat treatment of the kind described

10 in EP-A-23776.

15

Polymeric films in accordance with the invention may be prepared in a range of thicknesses governed primarily by the ultimate application for which a particular film is to be employed and may for example have a total thickness in a range from about 2.5 microns to about 120 microns.

20

The films of the present invention may be used as facestock film for label and/or graphic art applications in combination with any suitable conventional surface treatments, other facestocks, primer layers, adhesives, release layers, liners and/or back treatment compatible and/or suitable for use with the films of the present invention as would be well known to a person skilled in the field of labels, film converting and/or graphic arts.

Further aspects, embodiments and/or preferred features of the present invention are given in the claims.

25

The invention is illustrated by some non limiting Figures herein where:

Figure 1 is a plot of percentage shrinkage results of films in the MD versus temperature, (data given in Table 7);

Figure 2 is a plot of percentage shrinkage results of films in the TD versus temperature (data given in Table 8); and

Figure 2 is a plot of Handle-o-meter results of films at the "beta" setting (data given in Table 9).

35

The invention is further illustrated by reference to the following Examples, which are by way of illustration only and are not limiting to the scope of the invention described herein. In the Examples, a five layered laminated BOPP film is prepared by a bubble process as follows.

Bubble process

5 A film is formed by the coextrusion of three compositions through a triple channel annular die. A polypropylene composition (denoted as Composition A) from the middle channel of the die forms the core layer of the bubble, the composition in the outermost channel of the die forms the exterior surface of the bubble (denoted as composition B), and the composition from the inner channel forms the interior surface of the bubble (denoted as composition C).

10 As the three compositions are coextruded, air is blown through the die to form a tubular bubble which is cooled by passage over a mandrel within the tube, and it is externally quenched by passage through a water bath surrounding the mandrel. The tube is then heated to stretching temperature, expanded by internal gas pressure to form the bubble, and withdrawn from an expansion zone at a rate greater than that at which it is fed thereto, so that the bubble is stretched to seven times its original dimensions in both the direction of extrusion  
15 (MD) and in a direction transverse thereto (TD). The stretched tubular film is then collapsed whilst being heated, thereby forming a flat laminated film which is subsequently heat-set at a temperature between 120°C and 130°C on a matt-surfaced roller heat-setter (e.g. of the kind described in GB1124886-A).

20 The resultant five layered film consists of two three layered films laminated together by layers of Composition C on the interior of the bubble to form a core layer surrounded by two identical layers of Composition A and two identical outer layers of composition B which form the two outer surfaces of the film. Thus the films formed by this method have a B/A/C/A/B layered structure, the film strictly speaking being a six layer film since the inner core layer formed from Composition C is formed by laminating two such layers together.

25 In the following examples, the outer layer of Composition B which forms the outer surface of the film has a mean thickness of from about 0.3 microns ( $\mu\text{m}$ ) to about 0.6 microns ( $\mu\text{m}$ ); and the central laminated inner layer of composition C has a mean thickness of from about 0.7 microns ( $\mu\text{m}$ ) to about 1.2 microns ( $\mu\text{m}$ ). The core layer of Composition A forms the rest of the thickness of the film.

30 All films tested herein had a total thickness of 50 microns ( $\mu\text{m}$ ).

35 The particular BOPP films made and tested herein were prepared by the bubble process as described above, where Composition B was a propylene (95% w/w) / ethylene (5% w/w)

copolymer; and Composition C was a propylene (82% w/w) / ethylene (1% w/w) / butylene-1 (17% w/w) terpolymer of low crystallinity.

It will be appreciated that other Examples (not necessarily tested herein) could be carried out by replacing any of Compositions A to C by other suitable compositions without departing from

5 the scope of the present invention. For example Composition A could be replaced by a polymer of polypropylene containing a small concentration (from about 0.5% to about 1.0% w/w) of polyethylene, and/or Composition B could be replaced by a propylene (82% w/w) / ethylene (4% w/w) / butylene-1 (4% w/w) terpolymer.

10 Examples 1 to 8 and Comp 1

Films of the invention were prepared as described herein where:

15 In a Comparative Example 1 (hereinafter Comp 1) the core layer Composition A was a stabilised propylene homopolymer suitable for film production with a melt flow index (MFI) measured at 230°C and 2.16 kg of about 6.5 to about 9.0:

20 In Examples 1 to 6 of the present invention the core layer Composition A was a polymer blend of (100-'x') % of a PP/PE random copolymer (with 3.5% PE) and 'x' % of a PP/PE block copolymer (similar proportion of PE) as described in Table 1.

Table 1

| Example | 1 | 2    | 3    | 4    | 5    | 6    |
|---------|---|------|------|------|------|------|
| 'x' %   | 0 | 10.0 | 18.5 | 27.6 | 36.9 | 53.0 |

25 In Example 7 of the present Invention the core layer comprises a blend of PP homopolymer with 20 % of a saturated styrenic block copolymer (that available commercially from Asahi Chemicals under the trademark Tuftec®, e.g. Tuftec® L515).

Results

30 At each stage the bubble was allowed to settle and samples were taken. The films were tested, and the results obtained are given below: The plot is for measurements at 3Hz frequency.

DMTA results

DMTA is the test method described herein and the following results were obtained for the E" (loss modulus) in MPa versus applied frequency from a conventional DMTA apparatus using in the method specified by the manufacturer of the apparatus.

5

Table 2

| Freq                             | TD     | TD   | TD    | MD     | MD    | MD    |
|----------------------------------|--------|------|-------|--------|-------|-------|
|                                  | 0.3 Hz | 3 Hz | 30 Hz | 0.3 Hz | 3 Hz  | 30 Hz |
| E" (dynamic loss modulus in MPa) |        |      |       |        |       |       |
| Comp I                           | 39.8   | 63.1 | 158.5 | 79.4   | 125.9 | 398.1 |
| Ex 7                             | 1.3    | 1.6  | 4.5   | 6.9    | 7.9   | 5.1   |

Critical results (Gloss, NAH, WAH)

Specular gloss is defined as the ratio of the luminous flux reflected from, to that incident on, the specimen for specified solid angles at the specular direction, i.e. the angles of incidence and reflection are equal. The angle used is 45°. Test method is based on ASTM D2457.

The Narrow Angle Haze (NAH) of a specimen is the parallel light which is scattered by more than 6 minutes (0.1°) of arc when passing through the film sample from the incident beam, and is measured in a conventional well known manner as a percentage of the total light transmitted through the film.

The Wide Angle Haze (WAH) of a specimen is the percentage of transmitted light which, in passing through the specimen, deviates from the incident beam by more than 2.5 degrees by forward scattering. It is measured using a test method described in ASTM D1003.

The results are given in table 3

Table 3

|    | Comp I           | Ex 1   | Ex 2   | Ex 3        | Ex 4       | Ex 5     | Ex 6     |
|----|------------------|--------|--------|-------------|------------|----------|----------|
| 30 | Gloss (no units) |        |        |             |            |          |          |
|    | Side 1 96.5      | 83.7   | 85.5   | 82.3        | 80.8       | 79.8     | 76       |
|    | Side 2 95.9      | 83.7   | 85.9   | 82.5        | 80.2       | 79.7     | 76.4     |
|    | NAH (%) 4 to 7   | 6 to 9 | 3 to 5 | 8.8 to 10.0 | 14.5 to 16 | 17 to 19 | 21 to 23 |
|    | WAH (%) 2.6      | 3.5    | 2.7    | 3.7         | 4.3        | 4.3      | 5.4      |

35

It can be seen from the results that the conformable films of the Invention (Examples 1 to 6) show acceptable optical properties compared to a conventional BOPP label film (Comp I).

Other mechanical results

5 Tensile strength, elongation to break and modulus (Young's Modulus) were measured in one method with one test sample. The modulus is first measured at a strain rate of 10% followed by tensile and elongation at 50% strain rate. The strain rate changes automatically at an extension of 1.5%. The test method was as described in National Standard ASTM D982 (1989). The results are given in Tables 4 to 6 that follow.

Table 4:

|    |                  | Comp 1               | Ex 1  | Ex 2  | Ex 3  | Ex 4  | Ex 5  | Ex 6 |
|----|------------------|----------------------|-------|-------|-------|-------|-------|------|
| 10 | Tensile Strength | MD 224.7             | 157.6 | 168.9 | 180.4 | 161.4 | 170.6 |      |
|    |                  | TD 194.6             | 177.2 | 156.5 | 159.8 | 148.8 | 152.8 |      |
| 15 |                  | (mN/m <sup>2</sup> ) |       |       |       |       |       |      |

Table 5:

|    |                | Comp 1   | Ex 1 | Ex 2  | Ex 3  | Ex 4  | Ex 5  | Ex 6 |
|----|----------------|----------|------|-------|-------|-------|-------|------|
| 10 | Elongation (%) | MD 82.67 | 78.6 | 89.19 | 114.1 | 84.13 | 97.97 | 86.8 |
|    |                | TD 106.3 | 147  | 119.9 | 121.4 | 118.2 | 140.8 |      |
| 15 |                | 118.3    |      |       |       |       |       |      |

Table 6:

|    |                 | Comp 1               | Ex 1  | Ex 2  | Ex 3  | Ex 4  | Ex 5 | Ex 6 |
|----|-----------------|----------------------|-------|-------|-------|-------|------|------|
| 10 | Young's Modulus | MD 1661              | 686.5 | 798.3 | 733.3 | 830.4 | 789  |      |
|    |                 | TD 1399              | 317.7 | 482.4 | 431   | 453.6 | 380  |      |
| 15 |                 | (mN/m <sup>2</sup> ) |       |       |       |       |      |      |

30 Shrinkage

The shrinkage test is designed to measure the thermal stability of the film and gives an indication of the films likely performance. Two test strips were cut from the centre of the sample film with their longest axis parallel to respectively the TD and the MD of the film each strip spaced 25cm apart in both the TD and MD. The shrinkage was calculated as

$$35 \quad \frac{(A - B)}{A} \times 100 = \% \text{ shrinkage}$$

## 12

where A is the original length of the sample and B is the length after being held in the oven for 1 minute at the specified temperature. An expansion is expressed as a negative shrinkage.

The two samples were heated at the same time to measure TD and MD shrinkage under the same conditions. The following results were obtained.

5

Table 7

Shrinkage (%) in MD for 1 min at specified temperatures

|    | Temp  | Comp 1 | Ex 1 | Ex 2 | Ex 3 | Ex 4 | Ex 5  | Ex 6 |
|----|-------|--------|------|------|------|------|-------|------|
| 10 | 80°C  | 0.4    | 1.53 | 1.6  | 1.2  | 1.2  | 1.3   |      |
|    |       | 1.13   |      |      |      |      |       |      |
|    | 90°C  | 1      | 2.4  | 2.6  | 2.5  | 2.07 | 2.27  | 2.2  |
|    | 100°C | 1.6    | 4.13 | 4.13 | 4    | 3.7  | 3.3   | 3.2  |
| 15 | 110°C | 2.67   | 6.7  | 6.9  | 6.93 | 6.4  | 6.1   | 6    |
|    | 120°C | 4.2    | 12.6 | 12.2 | 12.3 | 10.8 | 10.73 | 10   |
|    |       |        |      |      |      |      |       |      |

These results are plotted graphically in Figure 1 herein.

Table 8

Shrinkage (%) in TD for 1 min at specified temperatures

|    | Temp  | Comp 1 | Ex 1 | Ex 2 | Ex 3 | Ex 4  | Ex 5  | Ex 6 |
|----|-------|--------|------|------|------|-------|-------|------|
| 20 | 80°C  | -0.5   | -1.1 | -1.1 | -1.2 | -0.9  | -0.7  |      |
|    |       | 0.73   |      |      |      |       |       |      |
|    | 90°C  | -1.1   | -2   | -1.6 | -1.6 | -1.3  | -1.3  |      |
|    |       | 1.2    |      |      |      |       |       |      |
| 25 | 100°C | -1.3   | -2.5 | -2.3 | -2   | -1.4  | -1.5  |      |
|    |       | 1.1    |      |      |      |       |       |      |
|    | 110°C | -1.42  | -1.6 | -0.2 | -0.6 | -0.42 | -0.87 |      |
|    |       | 0.2    |      |      |      |       |       |      |
| 30 | 120°C | -1.3   | 5.1  | 6    | 4.6  | 4.4   | 4     |      |
|    |       |        | 4.33 |      |      |       |       |      |
|    |       |        |      |      |      |       |       |      |

These results are plotted graphically in Figure 2 herein.

Handle-O-Meter

The Handle-O-Meter test method used is described in: Thwing-Albert Handle-O-Meter Tester User Manual 1992 and also in the test standard IST 90.3-95 for the use of a Handle-O-Meter (fabric industry standard).

Table 9

| Setting alpha | Comp 1<br>n/m | Ex 1<br>n/m. | Ex 2<br>65.3 | Ex 3<br>50.4 | Ex 4<br>57.4 | Ex 5<br>58.3 | Ex 6<br>64 |
|---------------|---------------|--------------|--------------|--------------|--------------|--------------|------------|
|               |               |              |              |              |              |              |            |

## 13

|           |      |      |      |      |      |      |      |
|-----------|------|------|------|------|------|------|------|
| beta      | 55.9 | 42.2 | 19.2 | 16.2 | 19.8 | 18.4 | 22.9 |
| beta (MD) | 56.5 | 42.4 | 20.1 | 16.4 | 20.9 | 19.6 | 25.5 |
| beta (TD) | 55.3 | 42.1 | 18.9 | 16   | 19.2 | 17.2 | 20.3 |

Note : n/m = not measurable

5

These results are plotted graphically in Figure 3 herein.

The handle meter settings are denoted alpha and beta where alpha denotes 100g bar, 10mm gap, Teflon Plates; and beta denotes 100g bar, 20mm gap, Teflon Plates.

10

Other

The Examples were also evaluated visually as follows. The film was applied as a label in a conventional manner to a squeezable bottle. The labelled bottle was squeezed and allowed to return to its "natural" shape and this cycle was repeated. After several such cycles the visual appearance of the label on the bottle was examined for blemishes such as creasing.

15 Fewer blemishes indicate that the film was better able to conform to the changing surface of the bottle during squeezing. In these tests films of the invention (Examples 1 to 7) were evaluated consistently to have less blemishes (i.e. more conformable) than the conventional film Comp I.

20

CLAIMS

1. A biaxially oriented polyolefin single or multi-layer film which comprises at least one core layer comprising a propylenic polymer component and either an ethylenic polymer component or a styrenic polymer component characterised in that the dynamic loss modulus ( $E''$ ) of the film measured at 3 Hz and 25°C is:
  - (a) less than about 50 MPa measured in the transverse direction (TD); and/or
  - (b) less than about 100 MPa measured in the machine direction (MD).
2. A biaxially oriented polyolefin film as claimed in claim 1, in which the core layer comprises a blend of propylene and ethylene homopolymers.
3. A biaxially oriented polyolefin film as claimed in claim 1, in which the core layer comprises a blend of propylene and with a saturated styrenic block copolymer.
4. A biaxially oriented polyolefin film as claimed in claim 1, in which the core layer comprising a copolymer formed from at least propylene and ethylene monomers.
5. A film as claimed in either preceding claim, in which the core layer comprises:
  - a) a blend of PP homopolymer and a PP/PE random copolymer;
  - b) a blend of PP homopolymer and a PP/PE block copolymer;
  - c) a terpolymer of PP, PE and polybutylene (PB);
  - d) a blend of a PP/PE random copolymer and a PP/PE block copolymer;
  - e) a PP/PE random copolymer; and/or
  - f) a PP/PE block copolymer.where in the co or ter polymers the PE component comprises up to about 50% by weight.
6. A film as claimed in either preceding claim, in which the dynamic loss modulus ( $E''$ ) of the film measured at 3 Hz and 25°C is less than about 40 MegaPascals (MPa) measured in the transverse direction (TD).
7. A film as claimed in claim 6, in which  $E''$  is less than about 30 MPa measured in the TD.
8. A film as claimed in claim 7, in which  $E''$  is about 4.0 MPa measured in the TD.

9. A film as claimed in any preceding claim, in which the dynamic loss modulus ( $E''$ ) of the film measured at 3 Hz and 25°C is less than about 65 MegaPascals (MPa) measured in the machine direction (MD).

5 10. A film as claimed in claim 9, in which  $E''$  is less than about 50 MPa measured in the MD.

11. A film as claimed in claim 10, in which  $E''$  is about 8.0 MPa measured in the MD.

10 12. A label facestock comprising a film as claimed in any preceding claim.

13. An article labelled with a film as claimed in any of claims 1 to 11.

14. A graphic art display comprising a film as claimed in any of claims 1 to 11.

15 15. Use of a film as claimed in any of claims 1 to 11 in the label and/or graphic art fields.

16. A method of selecting those polymeric films which are of improved conformability suitable for labelling a deformable and/or irregular shaped article to having reduce blemishing thereon during use; the method comprising the steps of:

(a) preparing polymeric film comprising at least one core layer comprising a copolymer formed from at least propylene and ethylene monomers

(b) measuring the dynamic loss modulus ( $E''$ ) of the film at 3 Hz and 25°C

(c) selecting those film for labelling have the following properties:

25 (i)  $E''$  less than about 50 MPa measured in the transverse direction (TD);  
and/or

(ii)  $E''$  less than about 100 MPa measured in the machine direction (MD).

- 1 -

ABSTRACT

There is described a biaxially oriented polyolefin single or multi-layer film which comprises at least one core layer comprising a propylene polymer component and either an ethylenic polymer component or a styrenic polymer component characterised in that the dynamic loss modulus ( $E''$ ) of the film measured at 3 Hz and 25°C is:

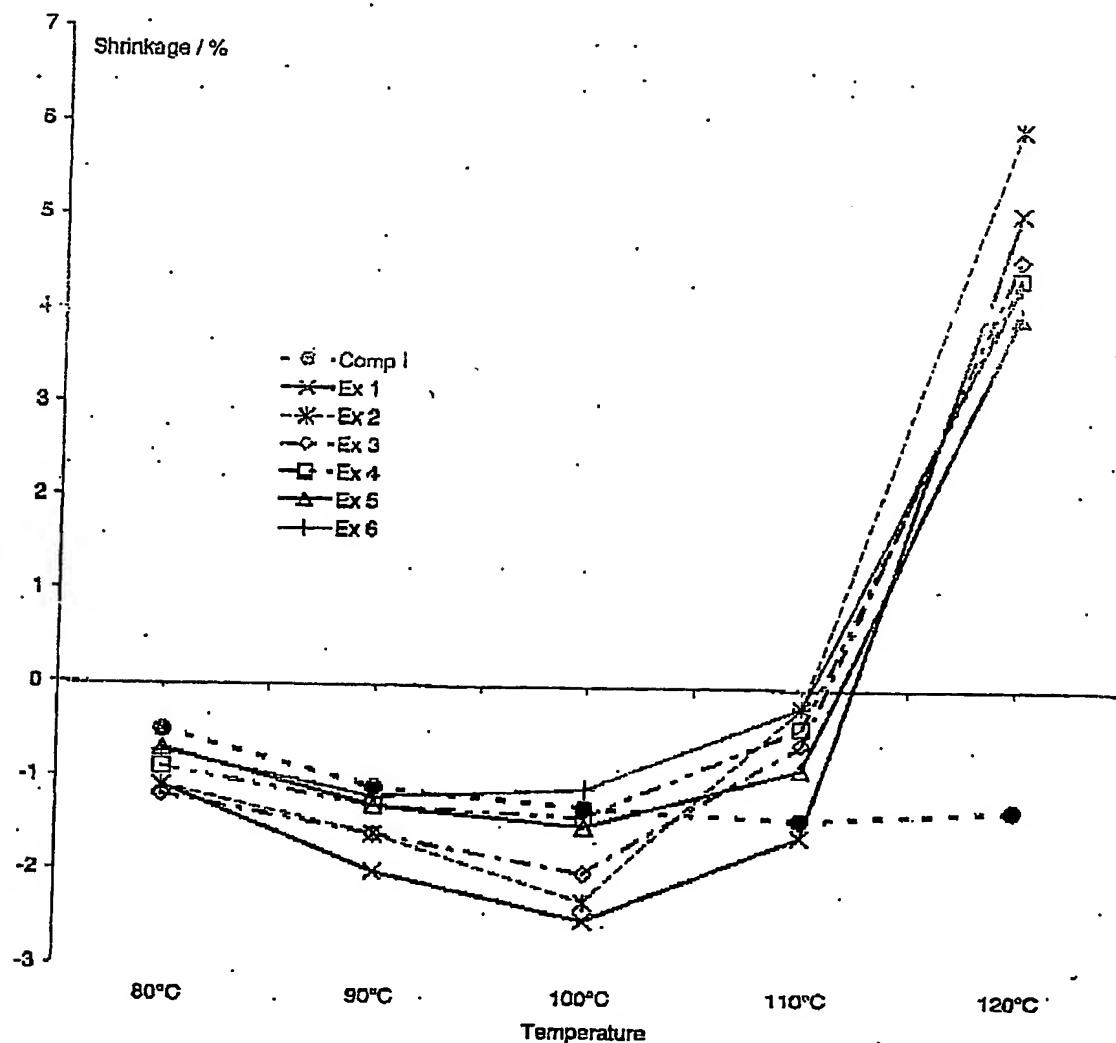
- 5 (a) less than about 50 MPa measured in the transverse direction (TD); and/or
- (b) less than about 100 MPa measured in the machine direction (MD).

These films are suitable for use as a label facestock with improved conformability.

10

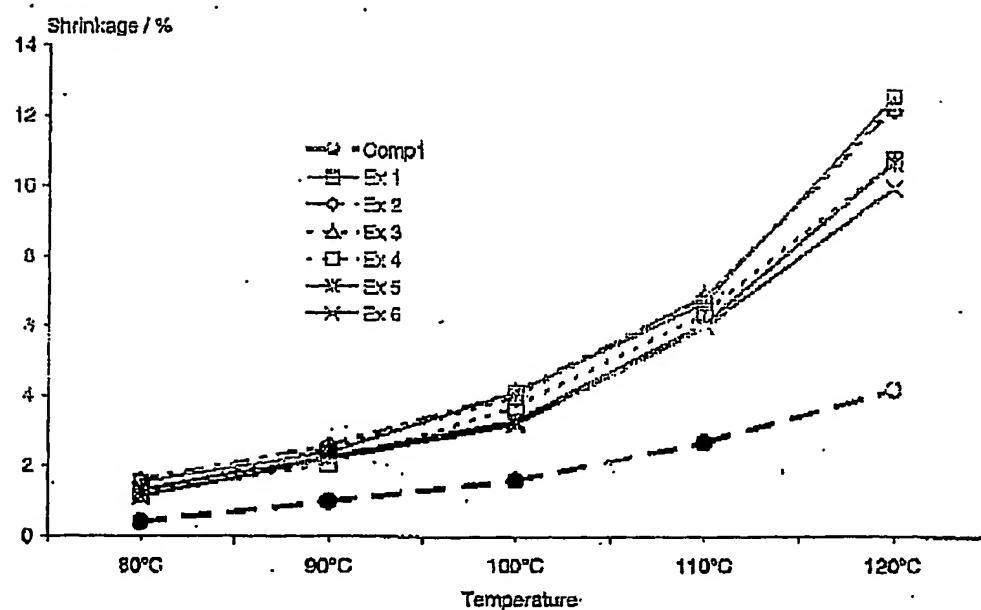
## FIGURES 1/3

Figure 1  
(% Shrinkage MD) – Table 7



## FIGURES 2/3

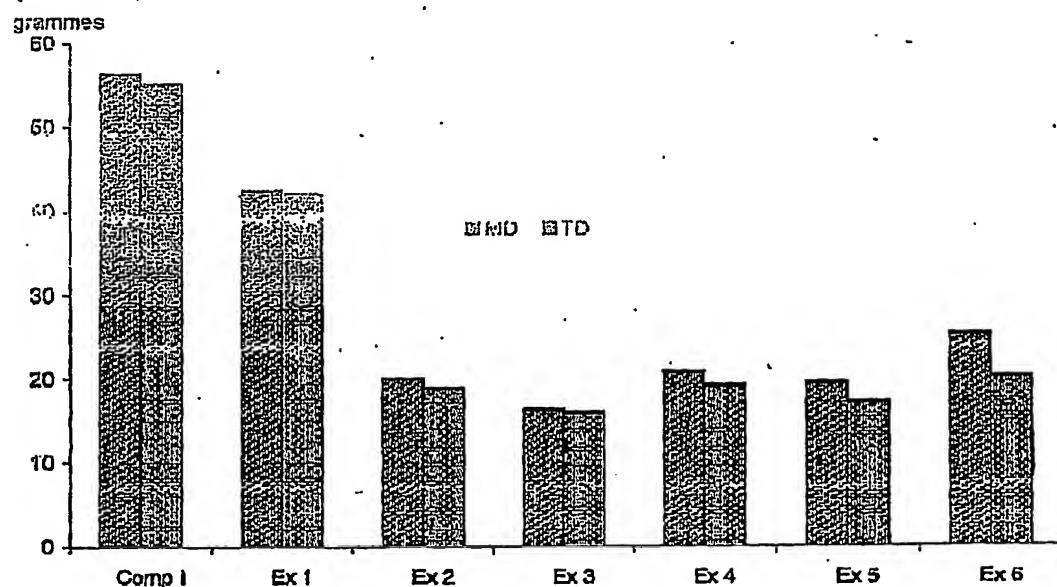
Figure 2  
(% Shrinkage TD) - Table 8



## FIGURES 3/3

5

Figure 3  
(Handle-o-meter results beta setting) – Table 9



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